Near Real-Time Prospecting for Lunar Volatiles: Demonstrating RESOLVE Science in the Field

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The Regolith and Environment Science and Oxygen & Lunar Volatile Extraction (RESOLVE) project aims to demonstrate the utility of "in situ resource utilization". In situ resource utilization (ISRU) is a way to rebalance the economics of spaceflight by reducing or eliminating materials that must be brought up from Earth and placed on the surface of the Moon for human use. RESOLVE is developing a rover-borne payload that (1) can locate near subsurface volatiles, (2) excavate and analyze samples of the volatile-bearing regolith, and (3) demonstrate the form, extractability and usefulness of the materials. Such investigations are important not only for ISRU but are also critically important for understanding the scientific nature of these intriguing lunar polar volatile deposits. Temperature models and orbital data suggest near surface volatile concentrations may exist at briefly lit lunar polar locations outside persistently shadowed regions. A lunar rover could be remotely operated at some of these locations for the 4-7 days of expected sunlight at relatively low cost. In July 2012 the RESOLVE project conducted a full-scale field demonstration. In particular, the ability to perform the real-time measurement analysis necessary to search for volatiles and the ability to combine the various measurement techniques to meet the mission measurement and science goals. With help from the Pacific International Space Center for Exploration Systems (PISCES), a lunar rover prototype (provided by the Canadian Space Agency) was equipped with prospecting instruments (neutron spectrometer and near-infrared spectrometer), subsurface access and sampling tools, including both an auger and coring drill (provided by CSA) and subsurface sample analysis instrumentation, including a sample oven system, the Oxygen and Volatile Extraction Node (OVEN), and Gas Chromatograph / Mass Spectrometer system, the Lunar Advanced Volatile Analysis (LAVA) system. Given the relatively short time period this lunar mission is being designed to, prospecting needs to occur in near real-time. The two prospecting instruments are the neutron and NIR spectrometers. In the field demo a small radioactive source was provided the neutron flux. The NIR spectrometer, which includes its own light source, looks at surface reflectance for signatures of bound H_2O/OH and general mineralogy. Once a “hot spot” was found by the prospecting instruments, the drill could either auger or core. The auger drill worked to a depth of 50 cm and is monitored with a drill camera and the NIR spectrometer. As cuttings are brought up the NIR spectra is monitored. If a particular location is considered of high-interest then the decision to core could be made. The coring drill (a push-tube) allowed a 1-meter sample to be acquired processed by the OVEN/LAVA sys-tem. This presentation will provide details as how these

instruments worked together and how and if the planned measurements and science was obtained.